- The resultant dispersion after allowing to settle for 2 h, was used to coat the inner wall of the throughly cleaned silica glass tubes with inner diameter of 17.8 mm. The outer wall of the tubes were properely masked with a suitable substance (parafilm).
- Coating was performed by dipping the silica glass tubes with a speed of 10 cm/min into the dispersion and lifting the same tube from the above dispersions with the same speed.
- The coated tubes were dried in air at 100°C for 1h.
- Oxidation at temperatures of 610° , 700°, 825° and 950°C with 2 passes of the burner at each temperature maintaining a constant $He/O_2$ ratio of 1:5 .
- The dehydration was carried out at a temperature of 1000°C with a $Cl_2$: $O_2$ ratio of 2 : 1 for a period of one hour.
- For sintering the temperature was increased in 4 steps up to 1220°C, each step consisting of 2 passes of the burner. $GeCl_4$ was added in controlled quantities during this stage with the input oxygen with two passes at 1220°C in order to adjust the NA of the preform / fibre.
- The tube was further heated to increase the temperature stepwise to 1600°C for complete sintering of the Ge, Eu & Al containing coated layer. During sintering $O_2$ and He flow was in the ratio of of 4:1.
- The collapsing was done in 3 steps in the usual manner with positive oxygen pressure of 4 psi inside the tube to avoid any deformation in shape or geometry and excessive evaporation of $GeO_2$ or other oxides from the core.
- The core:clad ratio before overcladding was 7.2:125. The NA measured in the fibre was $0.14 \pm 0.01$ .
- The presence of Eu in the core was established from the characteristic fluoresence at 624 nm in the preform sample when excited at 392 nm.
- Spectral attenuation was measured in the fibre from 400 nm to 800 nm.

## EXAMPLE 4

**Tb-doped fibre**

- Amorphous silica microspheres synthesized by hydrolysis of tetraethoxyorthosilicate (Stober method) were dispersed in a solution of terbium nitrate (kept in an ice bath) in a proportion of 98.5 mol% $SiO_2$ and 1.5 mol% $Tb_2O_3$ under sonication followed by the addition of aqueous ammonia by known process. The resulting product was washed with water followed by centrifugation and drying under vacuum.
- A stable dispersion of composition 95.9$SiO_2$: 2$GeO_2$ : 2$Al_2O_3$: 0.1 $Tb_2O_3$ (in equivalent oxide mol%) was prepared for the application of coating to the inner wall of high purity clear fused silica glass tubes.
- From the terbium oxide ($Tb_2O_3$) coated silica powders with 98.5 mol% $SiO_2$ and 1.5 mol% $Tb_2O_3$, a silica sol of composition of 95.9 equivalent mol% of $SiO_2$ and 0.1 equivalent mol% of $Tb_2O_3$ was prepared by diluting with a slica sol containing the desired amount of silicon tetraethoxide (TEOS).
- Silica-germania sol containing 2 equivalent oxide mol% of germanium ethoxide [$Ge(OC_2H_5)_4$] was prepared through the hydrolysis of TEOS and [$Ge(OC_2H_5)_4$] with water and hydrochloric acid in presence of a mixed solvent of propan-1-ol and butan-2-ol. pH of the above sol was 1.2 ± 0.05 .
- 2 equivalent oxide mol% of [$Al(NO_3)_3.9H_2O$] and 0.1 equivalent mol% of $Tb_2O_3$ through $Tb_2O_3$ coated $SiO_2$ powders (after baking at 100°C for 1h) were dispersed in the above silica sol under sonication (26 kHz) for 80 mins.
- The resultant dispersion after allowing to settle for 2 h, was used to coat the inner wall of the throughly cleaned silica glass tubes with inner diameter of 20.1 mm. The outer wall of the tubes were properely masked with a suitable substance (parafilm).
- Coating was performed by dipping the silica glass tubes with a speed of 10 cm/min into the dispersion and lifting the same tube from the above dispersions with the same speed.
- The coated tubes were dried in air at 150°C for 0.5h.

- Oxidation at temperatures of 720°, 825° and 950°C with 2 passes of the burner at each temperature maintaining a constant $He/O_2$ ratio of 1:6.
- The dehydration was carried out at a temperature of 950°C with a $Cl_2$: $O_2$ ratio of 2.5 : 1 for a period of one hour.
- For sintering the temperature was increased in 3 steps up to 1200°C, each step consisting of 2 passes of the burner. $GeCl_4$ was added in controlled quantities with the input oxygen during the passes at 1200°C in order to adjust the NA of the preform / fibre.
- The tube was further heated to increase the temperature stepwise to 1650°C for complete sintering of the Ge, Tb & Al containing coated layer. During sintering $O_2$ and He flow was in the ratio of of 4:1.
- The collapsing was done in 4 steps in the usual manner with positive oxygen pressure of 4 psi inside the tube to avoid any deformation in shape or geometry and excessive evaporation of $GeO_2$ or other oxides from the core.
- Overcladding was done to reduce the core:clad ratio to 5:125. The NA measured in the fibre was $0.11 \pm 0.01$ .
- The preform sample was excited at 355 nm and 400 nm and characteristic fluoresence of Tb was measured at 533 nm and 580 nm.
- Spectral attenuation was measured in the fibre from 400 nm to 800 nm

**Comparison of the characteristics of RE-doped fibre.fabricated at CGCRI using RE-coated silica nano particles w.r.t. commercially available fibres for special applications**

| Parameters | Commercial fibre | CGCRI fibre |
|---|---|---|
| Clad composition | $SiO_2$ or $SiO_2$ - $P_2O_5$ -F | Same |
| Core composition | $SiO_2$ +$GeO_2$ +$Al_2O_3$ + $Er_2O_3$ ($+P_2O_5$) | Same |
| Numerical aperture | 0.15 - 0.30 | 0.10 - 0.30 |
| Cut-off wavelength | 850 - 1450 nm | 850 - 1450 nm |
| RE-ion concentration | 50 - 2000 ppm | 50 - 4000 ppm |
| Fibre diameter | $125 \pm 1$ μm | $125 \pm 1$ μm |
| Coating diameter | 245 μm (nominal) | 245 μm |
| Mode Field Diameter | 3.5 - 8.0 μm | 3.0 - 8.0 μm |